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## **DEP's 1998 CRT/Electronics Recycling Strategy INFRASTRUCTURE DEVELOPMENT PLAN**

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Goal: Divert 25,000 tons per year (TPY) of cathode ray tubes (CRTs) and a wide range of electronics (VCRs, portable phones, etc.) from the municipal solid waste (MSW) stream through an affordable, strong private recycling infrastructure. The infrastructure should have capacity to accept more than 100,000 TPY of obsolete electric and electronic appliances.

Proposal: Strengthen the network of private recycling companies providing collections of electronic products by offering state contract and grant match for CRT collection costs, while promoting investment and purchases of environmentally preferred electronics.

Budget: \$400,000 per year for five years

Means: State service contract for collection or delivery.

Eligible entities: Municipalities collecting consumer electronics through the following voluntary mechanisms:

- municipal drop-off sites
- municipal seasonal curbside collections
- retailer take-back partnerships
- charitable collection partnerships
- moving company partnerships

Leveraged programs:

- State Environmentally Preferred Purchases (recycled content, recyclability)
- Recycling Industry Reimbursement Credit
- Recycling Loan Fund

## **Introduction:**

The Massachusetts Department of Environmental Protection (DEP) recently announced a new strategy for recycling of electronics and Cathode Ray Tubes (CRTs) in particular. This strategy has three components:

- Remove the hazardous waste stigma from CRT recycling by exempting intact units from hazardous waste regulations.
- Implement a solid waste disposal ban on CRTs, similar to bans already in place for tires, white goods (i.e. large home appliances) and car batteries.
- Provide financial incentives to establish a convenient, affordable infrastructure for the recycling of all types of consumer electronics, including a “closed loop” of collection, processing, demand and procurement.

This document, describing the Commonwealth’s plan to build up the electronics and CRT recycling infrastructure, should be read in conjunction with Massachusetts Environmental Policy Act (MEPA) filings and the cost-benefit analysis DEP performed on regulatory alternatives to the solid waste ban.

<b>Contents:</b>	1.	Defining the Electronics and CRT Problems
	2.	Developing a Recycling Strategy
	3.	Assessing the Current Demand for Used Electronics
	4.	Proposed CRT Ban — Mandatory Back-End Separation Strategy
	5.	Proposed Grant Support — Voluntary Front-End Separation
		Appendix A: Projected Quantity of Electronic Waste (data sources)
		Appendix B: History of Waste Bans

## 1. Defining the Electronics and CRT Problems:

Today, used electronics account for a fast-growing component of the solid waste stream. In Massachusetts, about 75,000 tons per year of TVs, VCRs, stereos, telephones, answering machines and other obsolete electronics are being recycled, disposed or placed in storage. While cathode ray tubes (CRTs) in particular represent about one third of this tonnage, their lead content may represent as much as 80 percent of the toxic metals in discarded electronics. While these toxics are encased in glass, their growing presence in the waste stream has created a regulatory atmosphere that could choke development of the private infrastructure necessary to recycle discarded electronics.

- The tonnage of CRTs generated annually will increase as more personal computers are purchased for household use.
- The tonnage of analog televisions sent for repair and resale will drop as broadcasters switch to digital high-definition TV broadcasts between 1998 and 2006.
- Three decades of CRTs stored in attics and basements will be “cleaned out” as consumers abandon the notion they still have value once analog TV transmissions are discontinued. Demographic changes expected in home ownership may also influence this clean-out.

Obsolete electric and electronic equipment is growing in volume and falling in value. Traditional resale and repair networks are in decline. Storage — the most common destination — only worsens the salvage value for this equipment. The problem is not the storage itself, but the capacity to recycle volumes of equipment which, some day in the near future, will flood into the waste stream without adequate infrastructure in place to recycle them.

The Massachusetts Department of Environmental Protection (DEP) anticipates that new standards for television broadcasts to be implemented over the next eight years will dramatically accelerate the turnover of televisions, VCRs, and other “non-digital” video and audio equipment, while limiting resale and repair to the export market. Depending on the rate of “clean-out,” the volume of discarded electronics may jump to 300,000 tons in one year — an amount difficult for the existing resale and recycling infrastructure to accommodate. (See Appendix A for quantitative analysis).

It is equally difficult for private traders to sell used electronics in the domestic retail market. Home appliance repair shops are in decline. Residents will therefore increasingly rely on non-profit organizations and municipal collection centers to accept units they no longer want.

Commercial generators have a more valuable waste product (i.e. computers, with higher value and higher precious metal content) and a lower tolerance for “storage.” The existing infrastructure — 48 electronics recycling collectors — is oriented to large commercial accounts. While the number of commercial electronics recyclers is expanding, this sector of the recycling industry is made up mostly of small entrepreneurial companies with a high failure rate. This dynamic infrastructure collects older computers and upgrades them for resale, or scavenges them for parts and recyclable components. Unfortunately, this “free market” has avoided low-value items (e.g., black and white TVs, rotary phones, etc.) and offers no guarantee of responding should there be a glut of them.

## 2. Developing a Strategy

Past experience in Massachusetts has shown that private recyclers provide the state's best hope for handling the influx of discarded material. DEP will strengthen the electronics recycling infrastructure in Massachusetts by contracting with these companies to provide services to municipalities at a fair but necessary cost.

While developing a system of grant incentives to support the electronics recycling infrastructure, DEP has also considered several regulatory policies to spur expansion. Both retailer deposit systems and regulation of CRTs as hazardous waste have been suggested, but following a cost-benefit analysis<sup>1</sup>, these approaches are not recommended by DEP.

- Take-back and deposit systems are inflexible. They require 100 percent of retailers to establish relationships with scrap processors, even in areas where it doesn't make sense. The strategy definitely encourages collection, resale and salvage, but also adds to the cost of goods, which in turn can generate strong business and consumer opposition.
- Regulation of intact CRTs as a hazardous waste intimidates recyclers, exporters and resellers in the private sector. Even "universal waste" regulations require recyclers to go through a lengthy and costly permitting process, carry additional insurance and comply with new management standards. Their recycling customers must also use licensed hazardous waste transporters and hazardous waste manifests. These requirements hurt pricing, which discourages recycling. Residential material, meanwhile, is completely exempt. In short, this policy discourages the collection of electronics, while diluting DEP's attention to the units thrown in the trash.

As a regulatory alternative, DEP will include CRTs, like white goods and tires, as part of its list of materials *banned from disposal* at Massachusetts landfills and combustion facilities. The waste ban will capture both residential and commercial CRTs, but the onus of separation and recycling *discarded* CRTs will fall on disposal facility operators, rather than on municipalities, office building managers or the recycling businesses. The CRTs collected for resale, upgrade, salvage or export will be unregulated unless they are disposed.

While this approach will keep lead-bearing CRTs out of solid waste disposal facilities and the environment, "back end" or "dump and pick" is not the most efficient way for private companies to recycle. Used electronics lose their "after market" value when commingled with wet trash. Prior to implementing the disposal ban, DEP will promote cost-effective, voluntary "front end" collections of these units (before they are commingled in the trash) by municipalities, institutions and businesses. DEP incentives will include free services that support private electronics recycling without forcing compliance by retailers or municipalities for whom collections do not make sense.

DEP's goal in banning CRT disposal and providing support to municipal collection programs is to divert recyclable electronics from burning, burial and temporary storage. How many of these units can be recovered and at what cost will be determined by the success of state, municipal and private sector efforts to collect them and expand recycling markets. Finally, DEP will also address access to recycling end-markets and procurement of products that support them. Through its own procurement practices, the state will encourage "source reduction" of electronics by original equipment manufacturers (e.g., through leasing rather than purchasing state computers, with preferences for recycled content).

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<sup>1</sup> See DEP's 1998 CRT/Electronics Recycling Strategy: Cost Benefit Analysis

### 3. Assessing the Current Demand for Used Electronics:

Forty-eight companies currently advertise electronics recycling services in Massachusetts. Twenty-seven of these firms are located in the state. Twelve accept TV sets (the lowest end CRTs). Few of these firms have more than 15 employees. All of them are extremely sensitive to demand for their scrap material. If the history of recycling is an indicator, then the future of the electronics processing infrastructure rests with these firms. Due in part to the increasing sophistication of electronics (making them harder to upgrade or less valuable to recycle for scrap), there has been a high rate of turnover among these companies.

Most of these businesses target commercial generators. Commercial electronics tend to consist of newer items like computers and telephone systems, which have a higher resale or recycling value. While businesses generate more electronics waste than households do today, residential storage of TVs and other household electronics has been going on for a longer period. The value of residential material is expected to be much lower, as non-digital residential electronics are difficult to sell and their scrap value is inherently less.

Private companies that accept discarded electronics use a “triage” system for determining appropriate markets, assigning each item one of four grades: Resale, Upgrade, Scrap or Export (RUSE). Most electronics recycling companies trade between the RUSE market niches to some degree, but they tend to focus on areas of specialty. Key players in the RUSE system include appliance repair shops, charities, junk yards and pawn brokers.

**Resale** is more a practice than a centralized infrastructure. Classified ads and organizations such as the Boston Computer Exchange pair individual consumers for an exchange of assets. Two New England colleges are currently replacing their existing computer “fleets” and offering the displaced older systems at bargain prices to both faculty and students. One company, Product Takeback Services, specializes in helping business and institutions employ similar “swap shop” arrangements.

**Upgrade** and repair businesses are surviving, but not thriving. One of the larger such operations in Massachusetts, East West Foundation, has 20 employees who refurbish and upgrade 286, 386 and 486 computers for placement in U.S. schools and export to poorer nations overseas. Like used car dealers, these businesses also create a market for salvaged parts. Working keyboards, monitors and memory are swapped to create a single working unit from two or three “broken” computers.

**Scrap** and salvage operations are often traditional scrap metal dealers attempting to recover precious metals from printed circuit boards, as well as Pentium chips and other valuable parts that can be sold to upgrade and repair shops. A few of these companies — including E.L. Harvey & Sons and Tombarello — have been in the scrap business since World War II and frequently quote the best prices.

**Export** is perhaps the strongest common denominator. There are excellent potential markets for upgraded units, spare parts and precious metals abroad. Export has traditionally been important to recycling businesses of all types, as well as to charities such as Goodwill, AmVets and the Salvation Army. The bulk of these items are sent overseas or south of the border, where American hand-me-downs are cherished.

As part of a 1998 pilot recycling program in Western Massachusetts, researchers with the University of Massachusetts will be visiting all of the companies serving these four recycling niches. The result of this pilot will be a series of recommendations to optimize these investments.

#### **4. Proposed CRT Ban — Mandatory Back-End Separation Strategy**

In 1998, DEP will announce the exemption of intact CRTs from the list of hazardous wastes, and at the same time will add CRTs to the list of items banned from disposal at Massachusetts landfills and incinerators. Like white goods (large home appliances), tires and car batteries, CRTs can be reasonably identified and set aside by disposal facility operators (DFOs) for recycling.

Since DEP-permitted DFOs are already required to perform routine inspections for banned materials including white goods, tires and car batteries, expanding the disposal ban to include CRTs will not create a significant new burden. While CRTs are more expensive to recycle than white goods on a per ton basis, CRTs are also lighter. Combustion facilities are likely to realize an overall reduction in their environmental costs if CRT removal lowers the lead content of their ash, thereby making it suitable for beneficial reuse.

Some municipalities are themselves DFOs. While the number of municipal landfills is in sharp decline, many towns and cities do operate solid waste transfer stations, which must begin waste ban inspections for all materials beginning in 1998. Grants to support CRT collections are included in the “front-end” incentives (section 6).

This “back end” model provides a “safety net” for the overall waste ban infrastructure. Municipalities that cannot organize front-end collections will not be penalized with load rejections. However, CRTs — unlike most other banned materials — are likely to be damaged in the course of collection and transport. While white goods and batteries retain scrap value after being sorted from loads, and tires are virtually unaffected by rough handling, CRTs are prone to be crushed or otherwise damaged in packer trucks. This can make sorting them difficult and significantly reduce their value on the parts and scrap market. So, even where facility floor sorting is possible, the costs are likely to outweigh the benefits.

It is for these reasons that DEP has a clear preference for source-segregated CRT recycling programs. The agency proposes to launch a new recycling grant program in support of voluntary source-separation of electronics by municipalities and businesses. These front-end collections would run concurrently with facility floor inspections to separate remaining CRTs from dumped loads.

*In the meantime, many municipalities can and do rely on back-end separation programs to handle banned white goods, tires, and auto batteries. The waste bans were not challenged as an “unfunded mandate” until mandatory front-end collections were introduced for paper, leaves, bottles and cans in 1993. However, new “transfer station” enforcement of ALL waste bans (announced in the 1997 Solid Waste Master Plan) will bring waste bans back to municipalities which operate their own transfer stations; this political issue will involve ALL solid waste ban inspections. (See Appendix B: History of Waste Bans).*

## 5. Proposed Grant Support — Voluntary Front-End Separation

While not required, “front end” source-separation of CRTs provides significant advantages:

- Source-separated units can be reused, repaired or salvaged for spare parts.
- CRT collections are nearly always part of broader collections targeting other electronics — VCRs, stereos, CB radios, telephones, kitchen appliances, etc. — with an “after market” value that can offset CRT handling costs. (A study done in Austria found that CRTs represented one-quarter of the weight but half of the cost associated with collecting used residential electronics.)

Private trash haulers serving large populations will likely respond by negotiating to eliminate CRTs from curbside collection contracts. These negotiations generally lead to a separate contract line for handling bulky items, the impacts of which are described below.

DEP will develop a voluntary front-end electronics collection infrastructure through a combination of grants to municipalities and incentives to commercial ventures that both discard and resell used electronics. Front-end collections of intact units are less expensive, environmentally sound, and more advantageous to recyclers than back-end separation of damaged units commingled with trash. At the same time, the agency wants these efforts to be voluntary and to target all electronics, not just CRTs.

As it has done for other recyclables, DEP will also address access to recycling markets and state procurement of products to support them. Through its own procurements, state government will practice “source reduction” of electronics by leasing rather than purchasing computers.

### A. Front-End Commercial Collections

A recent DEP/WasteCap survey of 48 electronic component recyclers providing service in Massachusetts found that 12 of them will accept a range of used components, including CRTs from black and white televisions and monochrome computer monitors. Some even indicated a willingness to accept wet and damaged units, provided sufficient quantities of intact units can be collected to make recycling cost-effective. All of these companies, however, are geared primarily toward resale, upgrade and salvage of intact units, so for them, front-end collection — before waste handling results in contamination or damage — is a must. Most of their clients are commercial generators of waste electronics. These businesses, in turn, are major purchasers of electronics. As such, they have clout with original equipment manufacturers (OEMs). This infrastructure is growing at no new cost to DEP and the disposal ban is likely to help existing recyclers in promoting their services.

DEP Effort	\$4M Recycling Loan Fund, Recycling Indus. Reimb. Credit Promotion and technical assistance
Cost	No new cost to DEP (Included in RLF, RIRC, NERC and WasteCap services)
Cost to Generators	Range from payment for material to \$100/ton (generally within avoided disposal costs)

## **B. Front-End Residential Collections**

DEP's goal is to make CRT recycling profitable for private businesses while providing targeted financial assistance to the municipalities whose collection programs will supply the feedstock. Source-separated residential electronics will undoubtedly be a challenge and expense for municipalities to collect. Residential electronics will tend to be older non-working TVs spread over thousands of square miles — posing a very different challenge than pallets of 386 computers on a loading dock, which is typical of the loads commercial recyclers encounter.

While these municipal collection programs will continue to develop and evolve in response to the actual results of pilot programs (described below), it is important to note that most residents will continue to store, repair and resell their equipment for the foreseeable future. The results of one-day collection programs show that consumer participation tends to be motivated by environmental ethics and "moving days" — which, together, account for a relatively small segment of the population. DEP's 1999 goal, therefore, is not to capture 100 percent of obsolete or broken CRTs, but to offer alternatives for the estimated 3,000 tons actually being discarded in today's waste stream.

In the beginning, towns and cities may be concerned about being pressured into providing more "bulk item" collection services. Although the disposal ban will not require towns and cities to collect discarded CRTs, there will eventually be a need for them to develop the infrastructure for doing so. The state's strategy is to encourage this through technical assistance and grant incentives.

For similar "bulky" banned items, municipalities currently employ one of four strategies:

- Some municipalities collect the items with the trash. DFOs pull those materials aside on the tipping floor and recycle them at their own expense. There is no Department-Approved Recycling Program (DARP) form requirement or any DEP standard for municipal participation in "front end" collection programs (see Back End collections).
- Some municipalities tell residents, "we don't accept those items" and refer them to a list of private recyclers (e.g., WasteCap's Recycling Services Directory or the Yellow Pages).
- Some municipalities offer monthly or seasonal "bulky item pick-ups" (some of these municipalities already accept TVs during these collections). Municipalities sometimes require the resident to purchase a "sticker" for between \$5 and \$25 per item. While white goods do have a better scrap market, they are also much heavier. In other words, a \$10 sticker raises \$100 per ton of white goods, but the same sticker would raise more than \$600 per ton of computers and TVs. DEP does not believe residents will expect to pay less for a TV sticker than for a refrigerator sticker, so these collections may create new revenue streams for municipalities.
- DEP pilot programs are working with retailers, charities and moving companies, all of which have experience handling unwanted appliances on a daily basis. Partnerships with these private collectors will reduce the pressure on municipalities to provide the service.

DEP began providing recycling grants to municipalities five years before banning disposal of containers and various grades of paper at Massachusetts landfills and combustion facilities. By the time these disposal bans took effect, most of the state's population lived in communities that already were diverting these items from the waste stream. Regional recycling programs supported by large state subsidies less than a decade ago are self-supporting and in most



cases in private hands today. DEP believes its grant program for electronics collections will follow a similar path.

Massachusetts will build the CRT collection and processing infrastructure by piloting new collection efforts and institutionalizing statewide contracts. The most successful approaches will be expanded to serve greater portions of the state, depending on actual costs and DEP's authorization to commit to annual spending beyond the current fiscal year. (The first stage of this program will be to pilot a range of collection alternatives to compare costs and recovery rates. These are listed in Table 3.)

Several front-end collection strategies have the potential to reduce the number of CRTs that eventually arrive at disposal facilities. To determine which are the most cost-effective, DEP will pilot one of each model in selected in the Spring of 1998:

- **The one-day drop-off model** has been successfully piloted in Somerville, as well as in other states. This model is particularly appropriate for that portion of the Massachusetts population (21 percent) that is served by permanent recycling drop-off facilities.
- **The seasonal curbside model** has been successfully used to collect yard wastes and bulky items such as white goods from residents who rely on curbside trash collection. Curbside collection of electronics may lead to scavenging and weather damage, but may also provide a significant boost to participation and recovery rates.
- **The retailer take-back model** is based on the existing retail practice of accepting old appliances as "trade-ins" when new ones are purchased. This model is attractive because the business community voluntarily subsidizes collections, thereby reducing the necessary level of state and municipal investment.
- **Charity drives** are common in many communities. Like institutional collections, they appeal to consumers who perceive high retained value in their used electronics. Both drop-off programs (e.g. Salvation Army in Leominster) and seasonal curbside programs (AmVets in metro Boston) are well established, but charities are sometimes perceived as "picky" about what they will accept. DEP wants to facilitate acceptance of non-working units for disposal. The related **institutional drop-off model** (schools and colleges) seeks to capitalize on the willingness of consumers to "donate" old electronics they perceive to have value but can't bring themselves to discard. Community colleges and universities have their own stores of waste electronics from dorms and system upgrades to manage. It may be possible to "piggyback" collections of less valuable residential electronics on those institutional efforts already underway.
- **Moving companies** regularly deal with attic and basement clean-outs. Currently, they are part of a three-way transaction (home buyer, seller and mover) in which no party may want the obsolete items. DEP wants to provide an incentive for these companies to enhance their customer service reputations by "dealing with" discarded electronics.

Depending on final costs (i.e., tons recovered multiplied by handling cost per ton), DEP grants and contracts established for the pilot program may be extended to a broader range of municipalities and businesses. Towns and cities can be assured that back-end separation at facilities to capture those units missed during front-end source separation will act as a "safety net" against "unfunded mandates."

Once the various approaches have been piloted, DEP will have actual tonnages and costs against which to make decisions about expansion of the different programs. If the Franklin County pilot collects a smaller volume of electronics than projected, for example, DEP might

expand the radius of the program to include communities in the Berkshires. Likewise, if the University of Massachusetts is able to identify companies willing to collect discarded electronics at a lower cost than those already on state contract, service could again be extended to additional towns and cities, with DEP offering “matching funds” to offset costs.

DEP Effort	Financial, technical, and contracting support
Cost	\$200,000 in grants and leveraged grants over a 6 month period
Cost to generator	Dedicated staff and organizational time / overtime Seasonal curbside collection costs est. \$50/ton Average tons per municipality per year in 1999: 7 Average cost: \$400, offset by sticker fees, grants and other (back-end, private) collection alternatives

### **C. Demand-Side Effort: Source Reduction and Procurement Standards**

DEP has not abandoned the concept of manufacturer responsibility. It has been the agency's experience that manufacturers are extremely sensitive to customer demand. With this in mind, DEP's Environmentally Preferred Product (EPP) Branch is working already to:

- Shift state computer procurements from outright purchases to five-year leases
- Draft “mandatory recycled content” standards for procurement of new monitors
- Establish other “preferred standards” to promote more recyclable electronics

DEP, working primarily with the University of Massachusetts and state's Executive Office for Administration and Finance (A&F), aims to use the state's clout as a major institutional purchaser to influence changes in manufacturer behavior.

At the same time, the agency will apply the experience it has gained from developing purchasing standards and collection models to encourage and promote “source reduction” at the retail level.

## **APPENDIX A: PROJECTED QUANTITY OF ELECTRONIC WASTE**

DEP has collected several speculative estimates on the quantity of electronics waste generated based on product life, sales data and collection pilots (see Table 1). Three out of four analyses (Table 1) indicate that CRT units (including TV housings and PC mainframes) account for approximately 25,000 of the 75,000 tons of electronics discarded annually (the other two analyses fall above and below those estimates).

Three unknown factors — used product resale, repair and “basement storage” — make exact tonnages difficult to determine. A Tufts University report estimates that 75 percent of obsolete CRTs are in “storage” while the OECD pegs the figure at 50 percent. Ultimately, however, these discarded electronics — like 8-track players and tapes from the 1970s — are more likely to wind up in landfills than in the Smithsonian Institution.

Waste volume will rise as the small business, institutional and residential sectors become less willing to repair or buy used electronics, and begin cleaning out the outmoded electronics from storage. As schools eventually discard their “donated” equipment and second-hand consumers are forced to buy “digital converter boxes” for used televisions, DEP expects several decades’ worth of stored equipment — an estimated 500,000 tons — to enter the waste stream in a relatively compressed period of time (between five and 15 years).

#### TABLE 1: DATA SOURCES AND ASSUMPTIONS:

The sources of data on electronics and CRT discarded and stored waste are speculative, but a review of several sources does provide the basis of a conservative range for Massachusetts (about 25,000 TPY of CRTs, or 1/3 of the 75,000 tons of electronics). We believe Massachusetts share to be higher than the national average due to higher home and business use of PCs, but are using round numbers in within the national range at this point.

- The OECD (Organization for Economic Cooperation and Development) estimates annual generation of 62 lbs per household of residential "waste electric and electronic equipment," with about 9.4 lbs of that coming from residential CRT items. Assuming the same rate for Massachusetts' 2.73M households, that results in 85,000 tons of electric and electronic appliances, and approximately **13,000 tons of residential CRTs**. With a commercial sold waste ratio of approximately 50 percent, the OECD approach estimates **26,000 tons of CRTs** in Massachusetts. The 1997 EU study includes white goods and other electric appliances in addition to electronics like VCRs and telephones. The study expects an annual growth rate of 3-5 percent.
- The Microelectronics and Computer technology Corp. (MCC) reports that 300,000 TPY of computers are disposed annually, along with approximately the same amount of TV sets. If Massachusetts has a proportional share of these wastes, that means approximately **13,000 TPY of CRTs** are discarded; (this number does not seem to include "storage", but is not explicit).
- The Wall Street Journal reports 79M PCs are sold in the US each year, or 1,600,000 tons. Massachusetts share by population would be **32,000 tons of PCs** sold in addition to any TV CRTs; Massachusetts actual purchases of PCs are much higher than the national average. If half of those are purchased as a replacement for an existing machine, the PC portion of the waste stream would be about 16,000 per year.
- Carnegie Mellon University produced a report in July 1997 which estimates that 143M PCs will be stored or recycled, while 55M are disposed by 2005. At 40 lbs. per PC, that results in nearly 4M tons per year, or a Massachusetts share of **80,000 TPY of PCs** (not including TVs). DEP is not relying on the CMU study, but provides it as evidence of our conservative estimates.
- DEP compared these speculations to an in-house analysis. That analysis assumes the average household has 2 CRTs (one TV and one PC or second TV) at 45 lbs per unit, with 2.7M households. Assuming a 10-year lifecycle, this yields **12,300 tons of residential CRTs per year**. If the workplace has approximately the same number (given that Mass. commercial waste is 65 percent of MSW, not all employees use computers, but a turnover rate under 10 years is likely), this brings the estimate to roughly **25,000 tons of CRTs** generated per year. Assuming a similar ratio of electronics to CRTs as in the other studies an additional **50,000 TPY of electronics** become a disposal problem. If 50 percent goes into storage, 25,000 hit the recycling and waste management systems. DEP projects that within the next five years, as many electronics will come OUT of storage as go INTO storage, resulting in a full 50,000 tons. Within 10 years, with the advent of digital and high-density technology, the previous 20 years of stored equipment will come out for disposal (20 years x 37,500 TPY stored = 750,000; plus 50K for year  $n = 800,000$  T) over a period of a few years, as people abandon hope of resale or repair, or change residences during the expected retirement boon.

## **Appendix B: History of Solid Waste Bans**

Since 1990, Massachusetts DEP has maintained a system of solid waste bans on disposal facilities and their customers operating in the Commonwealth. The waste bans were developed in response to authority granted by the solid waste statute, Chapter 111, section 150A, which allows DEP to limit or prohibit the disposal of particular types of solid waste to either preserve capacity at disposal facilities or to reduce the environmental impact of the banned material. The Waste Bans first targeted lead acid batteries in 1991. MSW landfills and combustion facilities are required to file an inspection plan detailing how these items will be identified and removed from loads of solid waste by inspectors at the facility. In 1992, the waste bans included inspection and removal of tires and white goods, which must be also be pulled aside on the facility tipping floor during regular load inspections. In Massachusetts, and in many other states, waste bans then evolved into a strategy to promote recycling.

In 1992, the DEP also announced the inclusion of leaves; this was expanded to other yard waste in 1993. Later, this waste ban approach was made to include residential recyclables, including glass and metal containers in 1993, and plastic containers and papers in 1995.

While bagged leaves can theoretically be removed at the disposal facility tipping floor, like tires or white goods, facility operators objected strongly, saying that the leaves, paper, and containers were commonly mixed with street sweepings, and that furthermore the ripping open of bags was potentially dangerous to facility personnel. Several facilities proposed instead to reject entire loads of solid waste containing any de minimus quantity of recyclables.

DEP agreed that leaves, bottles and cans, and paper were unlikely to be recyclable in a commingled state with MSW; to be realistically recycled, these residential materials should be source-separated by municipalities. Those municipalities, however, objected to the source-separation requirement as an “unfunded mandate” — especially if facilities carried through on their threats to reject all MSW loads containing de minimus quantities of these materials.

As a compromise, DEP announced a municipal exemption, to be earned by municipalities which made a good faith effort to make recycling systems reasonably accessible to all residents. To meet this standard, most municipalities file a “Department-Approved Recycling Program” [DARP] form, documenting that the municipality offers recycling to residents for each of the leaf, container, and paper materials targeted in the Waste Bans. The results of this strategy speak for themselves: by 1995, 97 percent of Massachusetts residents lived in a community which had earned DARP exemption for those materials — an increase in recycling access from 10 percent of residents in 1990.